



**INERGY MIDSTREAM LLC
WATKINS GLEN STORAGE FACILITY
WELL NO. 33
PROGRAM FOR NITROGEN-BRINE CAVERN MIT**

Job Number: 50813B

Date: 3/22/13

Page: 1 of 2

1.0 INTRODUCTION

The purpose of a Nitrogen-Brine Mechanical Integrity Test (MIT) is to determine if a storage system (wellbore and cavern) have mechanical integrity suitable for the storage of hydrocarbons. This MIT program consists of the following basic steps: a) Inject brine into the system until suitable pretest pressures are achieved; b) inject nitrogen into the system until the nitrogen-brine interface is below the cemented production casing shoe and at the appropriate test gradient is achieved; c) record the nitrogen wellhead pressure, brine wellhead pressure, wellbore temperature, and nitrogen-brine interface depth at the beginning and end of the test period.

2.0 PREPARATION

2.1 Provide skillets, blind flanges and/or double valves to isolate the well during the test. Test flanges with 2" connections may be required for product and brine wellhead valves.

2.2 Install pressure-monitoring equipment on well connections to allow continuous monitoring of nitrogen and brine wellhead pressures.

NOTE: Digital pressure recorders and a deadweight tester (digital or standard) utilized for the MIT shall be calibrated in accordance with manufacturer specifications and traceable to National Bureau of Standards.

2.3 Provide a top connection on the wellhead (2" I.D. minimum) to permit installing a wireline lubricator for well logging.

2.4 Provide a connection (2" minimum) to permit injecting nitrogen into the product annulus.

2.5 Pressurize the cavern by injecting saturated brine into the storage system. See the MIT Well Data Sheet for the approximate brine wellhead pressure and estimated volume of brine required.

2.6 Measure and record, at one-hour intervals, the volume of fluid injected and the wellhead brine pressure. The rate of pressurization should not exceed 2.5 psi per minute.

2.7 Monitor brine wellhead pressures until it stabilizes at an acceptable test pressure. Pressure decline rates should be less than 10 psi/day before starting the MIT.

3.0 NITROGEN INJECTION

3.1 Rig up wireline logging unit and install a lubricator on wellhead. Run base density (Gamma-Gamma Ray) and temperature log. Temperature log should be completed from surface to approximately 100 feet below proposed interface depth. The base density log should be completed from 100 feet below the proposed interface location to 200 feet above the cemented casing shoe.

3.2 Rig up nitrogen pumping unit to inject into the product annulus and position the density tool at a depth of approximately 500' below ground surface. Start injecting nitrogen at a slow rate. Control the nitrogen injection temperature as close as possible average wellbore temperature measured by the base temperature log. Monitor and record nitrogen and brine pressures and flow conditions during injection. The MIT Well Data Sheet lists the appropriate wellhead test pressures. Monitor the differential nitrogen-brine pressure to insure the brine string is not subjected to collapse pressure condition.

3.3 Find the nitrogen-brine interface with the density tool as it passes the 500' depth then track the interface movement down the well by moving the tool down in 250' to 500' increments. Continue tracking the interface until it reaches approximately 40'-50' above the casing shoe. Record nitrogen and brine wellhead pressures and flow conditions at each point.

PREPARED BY

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**PB Energy
Storage
Services, Inc.**
ENGINEERING CONSTRUCTION OPERATIONS MAINTENANCE

**INERGY MIDSTREAM LLC
WATKINS GLEN STORAGE FACILITY
WELL NO. 33
PROGRAM FOR NITROGEN-BRINE CAVERN MIT**

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3.4 Log the interface depth and determine the nitrogen volume injected. Monitor nitrogen and brine wellhead pressures and interface movement for a minimum of 60 minutes to check for casing and wellhead leaks. Check all wellhead fittings and flanges and testing equipment fittings with liquid soap or equivalent to insure there are no wellhead leaks.

3.5 If no apparent casing or wellhead leaks are indicated, lower density tool to the casing shoe and resume nitrogen injection. Continue to meter nitrogen and monitor wellhead pressures.

3.6 Track the nitrogen interface as it passes the casing shoe to the planned interface depth stop nitrogen injection. Record nitrogen and brine pressure and flow conditions at regular depth intervals. Run a density log to verify the position of the nitrogen-brine interface relative to the production casing shoe. Determine total volume of nitrogen injected and estimate the borehole volume from casing shoe to interface.

See MIT Well Data Sheet for planned interface depth and estimated volumes.

3.7 After nitrogen injection, shut the well in to allow the nitrogen temperature to stabilize at the well temperature. Remove the logging tool from the well and close the logging valve.

3.8 During the temperature stabilization period, record nitrogen and brine wellhead pressures. Check all wellhead fitting and flanges with liquid soap or equivalent to insure there are no nitrogen leaks.

3.9 Determine the duration of the test using the appropriate test data and calculations.

4.0 TEST INITIALIZATION

4.1 Rig up wireline logging unit and install lubricator on wellhead. Run initial density and temperature logs. Temperature log should be completed from surface to approximately 100 feet below interface depth. The density log should be completed from 100 feet below the interface location to 200 feet above the production casing shoe.

4.2 Record nitrogen and brine wellhead pressures.

5.0 TEST FINALIZATION

5.1 After the planned test duration, run the final density and temperature logs. Temperature log should be completed from surface to approximately 100 feet below proposed interface depth. The density log should be completed from 100 feet below the interface location to 200 feet above the production casing shoe.

5.2 Record nitrogen and brine wellhead pressures.

5.3 If results indicate the test period must be extended, repeat steps 5.1 and 5.2 as required

5.4 After the test, bleed off the nitrogen pressure. After the piping is reconnected to the wellhead, bleed off the brine pressure to the pond. Do not allow the cavern pressure change to exceed 2.5 psi per minute.

6.0 REPORT ON TEST RESULTS

6.1 Prepare a written report presenting test programs, results and conclusions, along with a chronology of test activity, wireline logs, wellhead pressure records, and supporting calculations.

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REVIEWED BY

Nils Skans

DATE

3-22-13

CAVERN TEST DATA SHEET		3/21/13	
1.0 WELL DESCRIPTION		Project#	50813B
1.1 Name/Permit Number		33	
1.2 Operator		Inergy Midstream, LLC	
1.3 Location		Field	Watkins Glen
		County	Schuyler
		State	NY
		API No.	31-097-52932-00-01
1.4 Cemented Production Casing		Size O.D.	10 3/4 inches
		Size I.D.	10.192 inches
		Depth	2000 feet
		Weight	32.00 lbs/ft
		Grade	K-55
1.5 Liner		Size O.D.	8 5/8 inches
		Size I.D.	7.92 inches
		Depth	1975 feet
		Weight	32 lbs/ft
		Grade	K-55
1.6 Hanging Casing String		Size	4 1/2 inches
		Depth	2220 feet
		Weight	13.50 lbs/ft
		Grade	J-55
1.7 Total Depth		2262	feet
2.0 TEST PRESSURES			
2.1 Casing Shoe Depth		2000	feet
2.2 Test Gradient			psi/ft
2.3 Brine Specific Gravity			
2.4 Nitrogen Temperature			deg F
2.5 Nitrogen Interface Depth			feet
2.6 Casing Shoe Pressure			psig
2.7 Surface Brine Pressure			psig
2.8 Surface Nitrogen Pressure			psig
3.0 VOLUME ESTIMATE			
3.1 Total Volume to Casing Shoe			bbls
3.2 Volume from Casing Shoe to Interface			bbls
3.3 Total Displacement to Interface			bbls
3.4 Nitrogen Volume to Casing Shoe			SCF
3.5 Nitrogen Volume below Casing Shoe			SCF
3.6 Total Nitrogen Volume Required			SCF
4.0 COMPRESSIBILITY RESPONSE			
4.1 Cavern Volume (All 4 Caverns Combined)			bbls
4.2 Cavern Compressibility			bbls/psi
4.3 Cavern Pressure Increase Due to N ₂ Injection (All 4 Caverns)			psi
4.4 Cavern Pressure Prior to N ₂ Injection (Brine Only)			psi
4.5 Estimated Volume of Brine Needed to Prepressure Cavern			bbls



**INERGY MIDSTREAM LLC
WATKINS GLEN STORAGE FACILITY
WELL NO. 34
PROGRAM FOR NITROGEN-BRINE CAVERN MIT**

Job Number: 50813B

Date: 3/22/13

Page: 1 of 2

1.0 INTRODUCTION

The purpose of a Nitrogen-Brine Mechanical Integrity Test (MIT) is to determine if a storage system (wellbore and cavern) have mechanical integrity suitable for the storage of hydrocarbons. This MIT program consists of the following basic steps: a) Inject brine into the system until suitable pretest pressures are achieved; b) inject nitrogen into the system until the nitrogen-brine interface is below the cemented production casing shoe and at the appropriate test gradient is achieved; c) record the nitrogen wellhead pressure, brine wellhead pressure, wellbore temperature, and nitrogen-brine interface depth at the beginning and end of the test period.

2.0 PREPARATION

2.1 Provide skillets, blind flanges and/or double valves to isolate the well during the test. Test flanges with 2" connections may be required for product and brine wellhead valves.

2.2 Install pressure-monitoring equipment on well connections to allow continuous monitoring of nitrogen and brine wellhead pressures.

NOTE: Digital pressure recorders and a deadweight tester (digital or standard) utilized for the MIT shall be calibrated in accordance with manufacturer specifications and traceable to National Bureau of Standards.

2.3 Provide a top connection on the wellhead (2" I.D. minimum) to permit installing a wireline lubricator for well logging.

2.4 Provide a connection (2" minimum) to permit injecting nitrogen into the product annulus.

2.5 Pressurize the cavern by injecting saturated brine into the storage system. See the MIT Well Data Sheet for the approximate brine wellhead pressure and estimated volume of brine required.

2.6 Measure and record, at one-hour intervals, the volume of fluid injected and the wellhead brine pressure. The rate of pressurization should not exceed 2.5 psi per minute.

2.7 Monitor brine wellhead pressures until it stabilizes at an acceptable test pressure. Pressure decline rates should be less than 10 psi/day before starting the MIT.

3.0 NITROGEN INJECTION

3.1 Rig up wireline logging unit and install a lubricator on wellhead. Run base density (Gamma-Gamma Ray) and temperature log. Temperature log should be completed from surface to approximately 100 feet below proposed interface depth. The base density log should be completed from 100 feet below the proposed interface location to 200 feet above the cemented casing shoe.

3.2 Rig up nitrogen pumping unit to inject into the product annulus and position the density tool at a depth of approximately 500' below ground surface. Start injecting nitrogen at a slow rate. Control the nitrogen injection temperature as close as possible average wellbore temperature measured by the base temperature log. Monitor and record nitrogen and brine pressures and flow conditions during injection. The MIT Well Data Sheet lists the appropriate wellhead test pressures. Monitor the differential nitrogen-brine pressure to insure the brine string is not subjected to collapse pressure condition.


3.3 Find the nitrogen-brine interface with the density tool as it passes the 500' depth then track the interface movement down the well by moving the tool down in 250' to 500' increments. Continue tracking the interface until it reaches approximately 40'-50' above the casing shoe. Record nitrogen and brine wellhead pressures and flow conditions at each point.

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 PB Energy Storage Services, Inc. <small>ENGINEERING CONSTRUCTION OPERATIONS MAINTENANCE</small>	INERGY MIDSTREAM LLC WATKINS GLEN STORAGE FACILITY WELL NO. 34 PROGRAM FOR NITROGEN-BRINE CAVERN MIT	Job Number: 50813B
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3.4 Log the interface depth and determine the nitrogen volume injected. Monitor nitrogen and brine wellhead pressures and interface movement for a minimum of 60 minutes to check for casing and wellhead leaks. Check all wellhead fittings and flanges and testing equipment fittings with liquid soap or equivalent to insure there are no wellhead leaks.

3.5 If no apparent casing or wellhead leaks are indicated, lower density tool to the casing shoe and resume nitrogen injection. Continue to meter nitrogen and monitor wellhead pressures.

3.6 Track the nitrogen interface as it passes the casing shoe to the planned interface depth stop nitrogen injection. Record nitrogen and brine pressure and flow conditions at regular depth intervals. Run a density log to verify the position of the nitrogen-brine interface relative to the production casing shoe. Determine total volume of nitrogen injected and estimate the borehole volume from casing shoe to interface.

See MIT Well Data Sheet for planned interface depth and estimated volumes.

3.7 After nitrogen injection, shut the well in to allow the nitrogen temperature to stabilize at the well temperature. Remove the logging tool from the well and close the logging valve.

3.8 During the temperature stabilization period, record nitrogen and brine wellhead pressures. Check all wellhead fitting and flanges with liquid soap or equivalent to insure there are no nitrogen leaks.

3.9 Determine the duration of the test using the appropriate test data and calculations.

4.0 TEST INITIALIZATION

4.1 Rig up wireline logging unit and install lubricator on wellhead. Run initial density and temperature logs. Temperature log should be completed from surface to approximately 100 feet below interface depth. The density log should be completed from 100 feet below the interface location to 200 feet above the production casing shoe.

4.2 Record nitrogen and brine wellhead pressures.

5.0 TEST FINALIZATION

5.1 After the planned test duration, run the final density and temperature logs. Temperature log should be completed from surface to approximately 100 feet below proposed interface depth. The density log should be completed from 100 feet below the interface location to 200 feet above the production casing shoe.

5.2 Record nitrogen and brine wellhead pressures.

5.3 If results indicate the test period must be extended, repeat steps 5.1 and 5.2 as required

5.4 After the test, bleed off the nitrogen pressure. After the piping is reconnected to the wellhead, bleed off the brine pressure to the pond. Do not allow the cavern pressure change to exceed 2.5 psi per minute.

6.0 REPORT ON TEST RESULTS

6.1 Prepare a written report presenting test programs, results and conclusions, along with a chronology of test activity, wireline logs, wellhead pressure records, and supporting calculations.

PREPARED BY <i>mtt QL</i> DATE <i>3-22-13</i>	REVIEWED BY <i>Nils Skaug</i> DATE <i>3-22-13</i>
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CAVERN TEST DATA SHEET		3/21/13	
1.0 WELL DESCRIPTION		Project#	50813B
1.1 Name/Permit Number		34	
1.2 Operator		Inergy Midstream, LLC	
1.3 Location		Field	Watkins Glen
		County	Schuyler
		State	NY
		API No.	31-097-61-190-00-01
1.4 Cemented Production Casing		Size O.D.	5 1/2 inches
		Size I.D.	4.950 inches
		Depth	2222 feet
		Weight	16.00 lbs/ft
		Grade	J-55
1.5 Liner		Size O.D.	inches
		Size I.D.	inches
		Depth	feet
		Weight	lbs/ft
		Grade	
1.6 Hanging Casing String		Size	inches
		Depth	feet
		Weight	lbs/ft
		Grade	
1.7 Total Depth		2420	feet
2.0 TEST PRESSURES			
2.1 Casing Shoe Depth (Top of Cavern)			feet
2.2 Test Gradient			psi/ft
2.3 Brine Specific Gravity			
2.4 Nitrogen Temperature			deg F
2.5 Nitrogen Interface Depth			feet
2.6 Casing Shoe Pressure			psig
2.7 Surface Brine Pressure			psig
2.8 Surface Nitrogen Pressure			psig
3.0 VOLUME ESTIMATE			
3.1 Total Volume to Casing Shoe			bbls
3.2 Volume from Casing Shoe to Interface			bbls
3.3 Total Displacement to Interface			bbls
3.4 Nitrogen Volume to Casing Shoe			SCF
3.5 Nitrogen Volume below Casing Shoe			SCF
3.6 Total Nitrogen Volume Required			SCF
4.0 COMPRESSIBILITY RESPONSE			
4.1 Cavern Volume (All 4 Caverns Combined)			bbls
4.2 Cavern Compressibility			bbls/psi
4.3 Cavern Pressure Increase Due To N ₂ Injection (All 4 Caverns)			psi
4.4 Cavern Pressure Prior to N ₂ Injection (Brine Only)			psi
4.5 Estimated Volume of Brine Needed to Prepressure Cavern			bbls



**INERGY MIDSTREAM LLC
WATKINS GLEN STORAGE FACILITY
WELL NO. 43
PROGRAM FOR NITROGEN-BRINE CAVERN MIT**

Job Number: 50813B

Date: 3/22/13

Page: 1 of 2

1.0 INTRODUCTION

The purpose of a Nitrogen-Brine Mechanical Integrity Test (MIT) is to determine if a storage system (wellbore and cavern) have mechanical integrity suitable for the storage of hydrocarbons. This MIT program consists of the following basic steps: a) Inject brine into the system until suitable pretest pressures are achieved; b) inject nitrogen into the system until the nitrogen-brine interface is below the cemented production casing shoe and at the appropriate test gradient is achieved; c) record the nitrogen wellhead pressure, brine wellhead pressure, wellbore temperature, and nitrogen-brine interface depth at the beginning and end of the test period.

2.0 PREPARATION

2.1 Provide skillets, blind flanges and/or double valves to isolate the well during the test. Test flanges with 2" connections may be required for product and brine wellhead valves.

2.2 Install pressure-monitoring equipment on well connections to allow continuous monitoring of nitrogen and brine wellhead pressures.

NOTE: Digital pressure recorders and a deadweight tester (digital or standard) utilized for the MIT shall be calibrated in accordance with manufacturer specifications and traceable to National Bureau of Standards.

2.3 Provide a top connection on the wellhead (2" I.D. minimum) to permit installing a wireline lubricator for well logging.

2.4 Provide a connection (2" minimum) to permit injecting nitrogen into the product annulus.

2.5 Pressurize the cavern by injecting saturated brine into the storage system. See the MIT Well Data Sheet for the approximate brine wellhead pressure and estimated volume of brine required.

2.6 Measure and record, at one-hour intervals, the volume of fluid injected and the wellhead brine pressure. The rate of pressurization should not exceed 2.5 psi per minute.

2.7 Monitor brine wellhead pressures until it stabilizes at an acceptable test pressure. Pressure decline rates should be less than 10 psi/day before starting the MIT.

3.0 NITROGEN INJECTION

3.1 Rig up wireline logging unit and install a lubricator on wellhead. Run base density (Gamma-Gamma Ray) and temperature log. Temperature log should be completed from surface to approximately 100 feet below proposed interface depth. The base density log should be completed from 100 feet below the proposed interface location to 200 feet above the cemented casing shoe.

3.2 Rig up nitrogen pumping unit to inject into the product annulus and position the density tool at a depth of approximately 500' below ground surface. Start injecting nitrogen at a slow rate. Control the nitrogen injection temperature as close as possible average wellbore temperature measured by the base temperature log. Monitor and record nitrogen and brine pressures and flow conditions during injection. The MIT Well Data Sheet lists the appropriate wellhead test pressures. Monitor the differential nitrogen-brine pressure to insure the brine string is not subjected to collapse pressure condition.

3.3 Find the nitrogen-brine interface with the density tool as it passes the 500' depth then track the interface movement down the well by moving the tool down in 250' to 500' increments. Continue tracking the interface until it reaches approximately 40'-50' above the casing shoe. Record nitrogen and brine wellhead pressures and flow conditions at each point.

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**INERGY MIDSTREAM LLC
WATKINS GLEN STORAGE FACILITY
WELL NO. 43
PROGRAM FOR NITROGEN-BRINE CAVERN MIT**

Job Number: 50813B

Date: 3/22/13

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3.4 Log the interface depth and determine the nitrogen volume injected. Monitor nitrogen and brine wellhead pressures and interface movement for a minimum of 60 minutes to check for casing and wellhead leaks. Check all wellhead fittings and flanges and testing equipment fittings with liquid soap or equivalent to insure there are no wellhead leaks.

3.5 If no apparent casing or wellhead leaks are indicated, lower density tool to the casing shoe and resume nitrogen injection. Continue to meter nitrogen and monitor wellhead pressures.

3.6 Track the nitrogen interface as it passes the casing shoe to the planned interface depth stop nitrogen injection. Record nitrogen and brine pressure and flow conditions at regular depth intervals. Run a density log to verify the position of the nitrogen-brine interface relative to the production casing shoe. Determine total volume of nitrogen injected and estimate the borehole volume from casing shoe to interface.

See MIT Well Data Sheet for planned interface depth and estimated volumes.

3.7 After nitrogen injection, shut the well in to allow the nitrogen temperature to stabilize at the well temperature. Remove the logging tool from the well and close the logging valve.

3.8 During the temperature stabilization period, record nitrogen and brine wellhead pressures. Check all wellhead fitting and flanges with liquid soap or equivalent to insure there are no nitrogen leaks.

3.9 Determine the duration of the test using the appropriate test data and calculations.

4.0 TEST INITIALIZATION

4.1 Rig up wireline logging unit and install lubricator on wellhead. Run initial density and temperature logs. Temperature log should be completed from surface to approximately 100 feet below interface depth. The density log should be completed from 100 feet below the interface location to 200 feet above the production casing shoe.

4.2 Record nitrogen and brine wellhead pressures.

5.0 TEST FINALIZATION

5.1 After the planned test duration, run the final density and temperature logs. Temperature log should be completed from surface to approximately 100 feet below proposed interface depth. The density log should be completed from 100 feet below the interface location to 200 feet above the production casing shoe.

5.2 Record nitrogen and brine wellhead pressures.

5.3 If results indicate the test period must be extended, repeat steps 5.1 and 5.2 as required

5.4 After the test, bleed off the nitrogen pressure. After the piping is reconnected to the wellhead, bleed off the brine pressure to the pond. Do not allow the cavern pressure change to exceed 2.5 psi per minute.

6.0 REPORT ON TEST RESULTS

6.1 Prepare a written report presenting test programs, results and conclusions, along with a chronology of test activity, wireline logs, wellhead pressure records, and supporting calculations.

PREPARED BY

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3-22-13

REVIEWED BY

Nils Skoug

DATE

3-22-13

CAVERN TEST DATA SHEET		3/21/13	
1.0 WELL DESCRIPTION		Project#	50813B
1.1 Name/Permit Number		43	
1.2 Operator		Inergy Midstream, LLC	
1.3 Location	Field	Watkins Glen	
	County	Schuyler	
	State	NY	
	API No.	31-097-61199-00-01	
1.4 Cemented Production Casing	Size O.D.	5 1/2	inches
	Size I.D.	4.950	inches
	Depth	2223	feet
	Weight	15.50	lbs/ft
	Grade	J-55	
1.5 Liner	Size O.D.	4 1/2	inches
	Size I.D.	4.21	inches
	Depth	2117	feet
	Weight	13.5	lbs/ft
	Grade	P110	
1.6 Hanging Casing String	Size		inches
	Depth		feet
	Weight		lbs/ft
	Grade		
1.7 Total Depth		2351	feet
2.0 TEST PRESSURES			
2.1 Casing Shoe Depth (Top of Cavern)			feet
2.2 Test Gradient			psi/ft
2.3 Brine Specific Gravity			
2.4 Nitrogen Temperature			deg F
2.5 Nitrogen Interface Depth			feet
2.6 Casing Shoe Pressure			psig
2.7 Surface Brine Pressure			psig
2.8 Surface Nitrogen Pressure			psig
3.0 VOLUME ESTIMATE			
3.1 Total Volume to Casing Shoe			bbls
3.2 Volume from Casing Shoe to Interface			bbls
3.3 Total Displacement to Interface			bbls
3.4 Nitrogen Volume to Casing Shoe			SCF
3.5 Nitrogen Volume below Casing Shoe			SCF
3.6 Total Nitrogen Volume Required			SCF
4.0 COMPRESSIBILITY RESPONSE			
4.1 Cavern Volume (All 4 Caverns Combined)			bbls
4.2 Cavern Compressibility			bbls/psi
4.3 Cavern Pressure Increase Due To N ₂ Injection (All 4 Caverns)			psi
4.4 Cavern Pressure Prior to N ₂ Injection (Brine Only)			psi
4.5 Estimated Volume of Brine Needed to Prepressure Cavern			bbls



**INERGY MIDSTREAM LLC
WATKINS GLEN STORAGE FACILITY
WELL NO. 44
PROGRAM FOR NITROGEN-BRINE CASING TEST
AND CAVERN PRESSURE OBSERVATION TEST**

Job Number: 50813B

Date: 3/22/13

Page: 1 of 2

1.0 INTRODUCTION

A nitrogen/brine interface test method will be used for the casing test and a pressure observation test (POT) method will be used for the casing shoe and cavern test. A POT is proposed since this cavern does not have a borehole with a narrow cross section that allows for a short duration nitrogen/brine interface test.

The purpose of the Mechanical Integrity Test (MIT) procedure is to test the mechanical integrity of the underground storage cavern to determine the suitability for storage of hydrocarbons. In summary, the test procedure consists of the following basic steps: Pressuring the cavern with brine to a given test pressure; injecting nitrogen into the well so that the nitrogen/brine interface is in the near the casing shoe; recording the nitrogen and brine wellhead pressures throughout a given test period. In addition, record the nitrogen/brine interface level at the start and end of the casing test.

2.0 PREPARATION

- 2.1 Provide skillets, blind flanges and/or double valves to isolate the well during the test. Test flanges with 2" connections may be required for product and brine wellhead valves.
- 2.2 Install pressure-monitoring equipment on well connections to allow continuous monitoring of nitrogen and brine wellhead pressures.

NOTE: Digital pressure recorders and a deadweight tester (digital or standard) utilized for the mechanical integrity test shall be calibrated in accordance with manufacturer specifications and traceable to National Bureau of Standard.
- 2.3 Provide a top connection on the wellhead (2" I.D. minimum) to permit installing a wireline lubricator for well logging.
- 2.4 Provide a connection (2" minimum) to permit injecting nitrogen into the product annulus.
- 2.5 Pressurize the cavern by injecting saturated brine into the hanging string of the subject well. See the MIT Well Data Sheet for the approximate brine wellhead pressure and estimated volume of brine required.
- 2.6 Measure and record, at one-hour intervals, the volume of fluid injected and the wellhead brine pressure. The rate of pressurization should not exceed 2.5 psi per minute.
- 2.7 Monitor brine wellhead pressures until it stabilizes at an acceptable test pressure. Pressure decline rates should be less than 10 psi/day before starting the test.

3.0 NITROGEN INJECTION

- 3.1 Rig up wireline logging unit and install a lubricator on wellhead. Run base density (Gamma-Gamma Ray) and temperature log. Temperature log should be completed from surface to approximately 100 feet below proposed interface depth. The base density log should be completed from 100 feet below the proposed interface location to 200 feet above the cemented casing shoe.
- 3.2 Rig up nitrogen pumping unit to inject into the product annulus and position the density tool at a depth of approximately 500'. Start injecting nitrogen at a slow rate. Control the nitrogen injection temperature as close as possible average wellbore temperature measured by the base temperature log. Monitor and record nitrogen and brine pressures and flow conditions during injection. The MIT Well Data Sheet lists the appropriate wellhead test pressures. Monitor the differential nitrogen-brine pressure to insure the brine string is not subjected to collapse pressure condition.

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**INERGY MIDSTREAM LLC
WATKINS GLEN STORAGE FACILITY
WELL NO. 44
PROGRAM FOR NITROGEN-BRINE CASING TEST
AND CAVERN PRESSURE OBSERVATION TEST**

Job Number: 50813B

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- 3.3 Find the nitrogen/brine interface with the density tool as it passes the 500' depth then track the interface movement down the well by moving the tool down in 250' to 500' increments. Continue tracking the interface until it reaches approximately 10'-30' above the casing shoe. Record nitrogen and brine wellhead pressures and flow conditions at each point.
- 3.6 After nitrogen injection, shut the well in to allow the nitrogen temperature to stabilize at the well temperature. Remove the logging tool from the well and close the logging valve.
- 3.7 During the temperature stabilization period, record nitrogen and brine wellhead pressures. Check all wellhead fitting and flanges with liquid soap or equivalent to insure there are no nitrogen leaks.
- 3.8 Determine the duration of the test using the appropriate test data and calculations.

4.0 TEST INITIALIZATION

- 4.1 Rig up wireline logging unit and install lubricator on wellhead. Run initial density and temperature logs. Temperature log should be completed from surface to approximately 100 feet below interface depth. The base density log should be completed from 100 feet below the interface location to 200 feet above the cemented casing shoe.
- 4.2 Record nitrogen and brine wellhead pressures.

5.0 TEST FINALIZATION

- 5.1 After the planned test duration, run the final density and temperature logs. Temperature log should be completed from surface to approximately 100 feet below proposed interface depth. The base density log should be completed from 100 feet below the proposed interface location to 200 feet above the cemented casing shoe.
- 5.1 Record nitrogen and brine wellhead pressures.
- 5.2 If results indicate the test period must be extended, repeat steps 5.1 and 5.2 as required.
- 5.3 After the test, continue monitoring the surface pressure for a minimum of two weeks as part of the POT.

6.0 REPORT ON TEST RESULTS

- 6.1 Prepare a written report presenting test procedures, results and conclusions, along with a chronology of test activity, wireline logs, wellhead pressure records, and supporting calculations.

PREPARED BY

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DATE 3/22/13

REVIEWED BY

Nils Skaus

DATE

3-22-13

CASING TEST DATA SHEET

3/21/13

1.0 WELL DESCRIPTION

Project# 50813B

1.1 Name/Permit Number

44

1.2 Operator

Inergy Midstream, LLC

1.3 Location

Field Watkins Glen

County

Schuyler

State

NY

API No.

31-097-61200-00-01

1.4 Cemented Production Casing

Size O.D.

8 5/8

inches

Size I.D.

7.825

inches

Depth

2270

feet

Weight

36.00

lbs/ft

Grade

J-55

1.5 Liner

Size O.D.

6 5/8

inches

Size I.D.

5.92

inches

Depth

2423

feet

Weight

24

lbs/ft

Grade

1.6 Hanging Casing String

Size

inches

Depth

feet

Weight

lbs/ft

Grade

1.7 Total Depth

2405

feet

2.0 TEST PRESSURES

2.1 Casing Shoe Depth (Top of Cavern)

feet

2.2 Test Gradient

psi/ft

2.3 Brine Specific Gravity

2.4 Nitrogen Temperature

deg F

2.5 Nitrogen Interface Depth

feet

2.6 Casing Shoe Pressure

psig

2.7 Surface Brine Pressure

psig

2.8 Surface Nitrogen Pressure

psig

3.0 VOLUME ESTIMATE

3.1 Total Volume To Casing Shoe

bbls

3.2 Volume from Casing Shoe to Interface

bbls

3.3 Total Displacement to Interface

bbls

3.4 Nitrogen Volume To Interface

SCF

4.0 COMPRESSIBILITY RESPONSE

4.1 Cavern Volume (All 4 Caverns Combined)

bbls

4.2 Cavern Compressibility

bbls/psi

4.3 Cavern Pressure Increase Caused by N₂ Injection (All 4 Caverns)

psi

4.4 Cavern Pressure Prior to N₂ Injection (Brine Only)

psi

4.5 Estimated Volume of Brine Needed to Prepressure Cavern

bbls